

**POST-FOX REMOVAL WILDLIFE SURVEYS AT AVATANAK ISLAND,
ALASKA IN 2007**



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Key Words: Arctic fox, black oystercatcher, habitat restoration, harbor seal, invasive species, pigeon guillemot, rock sandpiper, seabird, sea otter, shorebird

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INTRODUCTION

The oil spill settlement associated with the M/V *Kuroshima*, which went aground in November 1996 at Unalaska Island, included a project to remove introduced foxes from nearby Avatanak Island in order to restore native bird populations including species injured by the spill. Arctic foxes (*Alopex lagopus*) were introduced to Avatanak in 1920 and probably had some effect on native wildlife although we have no early accounts of wildlife on the island prior to fox introduction. Arctic and red foxes (*Vulpes vulpes*) were introduced on many islands in the Aleutians for fur ranching purposes before 1930 and these predators extirpated or seriously reduced populations of native birds (Bailey 1993). Since 1949, U.S. Fish and Wildlife Service and U.S. Dept. of Agriculture, Wildlife Services personnel have eradicated introduced foxes from more than 40 islands within the Alaska Maritime National Wildlife Refuge to restore native bird populations (Ebbert and Byrd 2002). After fox removal many species of native birds reoccupy islands and reduced populations increase (Byrd et al. 1994) including the once-endangered Aleutian cackling goose (*Branta hutchinsii leucopareia*, Byrd 1998).

As part of the overall project, the Kuroshima Trustee Council approved pre- and post-fox removal bird surveys to document the response of selected species to this restoration project. The pre-eradication bird survey was conducted in 2002 (Byrd and Williams 2002), and foxes were removed from Avatanak in 2004 (Thomson 2004, Ebbert and Byrd 2005). We conducted post-eradication surveys in 2007 (this report).

Recovery of native birds has varied among species at other Aleutian islands where introduced foxes have been removed (Byrd et al. 1994). Typically, gulls and black oystercatchers (*Haematopus bachmani*) (both ground nesting species highly susceptible to fox predation) are among the species that begin recovery first. These species respond to fox removal sometimes the first summer after foxes are eradicated, particularly if pairs of birds are already nesting on nearby offshore islets and provide a repopulation source. Confirmation of nesting by these species has been used as evidence of successful fox removal (Bailey 1993). Other birds that manage to maintain small, reduced populations when foxes are still present on islands, such as waterfowl and some seabirds, may also show evidence of recovery within 3-5 years after fox removal.

Our objective at Avatanak in 2007 was to look for early evidence of recovery by native birds by repeating surveys conducted in 2002 (Byrd and Williams 2002), prior to fox removal in 2004 (Thomson 2004, Ebbert and Byrd 2005). Similar to 2002, our investigations in 2007 included an inventory of all the species present, as well as comparative (with 2002) population indices for waterfowl, shorebirds, birds-of-prey, seabirds, and landbirds.

Surveys in 2007 were conducted from the M/V *Tiglax* from 12-14 June 2007. Observers involved in various surveys included: Poppy Benson (Alaska Maritime NWR), Catherine Berg (USFWS, Ecological Services, Anchorage), Vernon Byrd (Alaska Maritime NWR), Carla Corin (USFWS volunteer, Anchorage), Lisa Matlock (Alaska Maritime NWR) and Jeff Williams (Alaska Maritime NWR). Heather Renner provided substantial comments

and review of this report. Brie Drummond commented, reviewed, formatted and produced this report. We appreciate both of their efforts.

STUDY AREA

Avatanak Island is located in the Krenitzen Island group in the eastern Aleutian Islands, Alaska. The island is approximately 3,700 ha in area and has 44 km of coastline. The interior is mountainous on the west and east ends of the island and has a gentle grade with rolling hills in the center. The highest point is 545 m in elevation. Most of the southern and eastern coasts are sheer cliffs. The southern coast has steep slopes and slides and nearshore areas are foul with submerged rocks. Kelp is prevalent on the north and eastern sides of the island but is not abundant along the southern coastline. Beaches tended to be narrow and short between cliffs and were mostly covered with boulders. The inter-tidal zone had numerous snails and limpets. Sea stacks were fairly common but there were few offshore islets with adequate soil for burrowing seabirds. The primary vegetation was a grass-tall forb association near the coast interspersed at medium elevations with dwarf shrub meadows containing crowberry, moss and lichen associations. The higher areas had more bare rock and sparse vegetation. More than 12 freshwater lakes and ponds occurred in the interior of the island.

METHODS

Nearshore Coastline Surveys

Two crews of 3 people each used inflatable boats to survey all birds and marine mammals visible on the water, on beaches and coastal talus slopes around the coastline of Avatanak. Surveys began each morning as soon as it was light enough to see well which usually was 0600-0630 AST depending on cloud cover. Boats were operated as close to shore as kelp and rocks allowed, usually within 50 m. The procedure was to move along slowly and document all wildlife in each of 11 sections covering the entire coastline (see Fig. 1). An operator, a recorder and a primary observer were in each boat. Besides observations of individuals, nesting colonies of seabirds and nest sites of bald eagles (*Haliaeetus leucocephalus*) were recorded. Species such as winter wrens (*Troglodytes troglodytes*) and song sparrows (*Melospiza melodia*) were not counted as they are difficult to regularly see from a boat. We used beach surveys (listed below) to document trends in these species.

Beach Surveys

To gather abundance indices winter wrens, song sparrows and other beach-associated passerines, 2 observers walked along designated stretches of beach (Fig. 1). One observer walked the high tide line and the other about 10 m inland from the high tide line. Each observer counted birds seen and heard on the beach and within 50 m inland. Because of conflicts of timing with the nearshore boat surveys, nearly all beach surveys

were conducted in the afternoon from 1200-1700h.

Lake Surveys

Ten lakes in the central portion of Avatanak (Fig. 1) were resurveyed for nesting birds. Two observers walked the perimeter of each lake line abreast, 10 m apart and documented all avifauna. Birds observed out to 50 m from lake margins were recorded as associated with the lake.

Off-Road Point Count

A standard 12-point route following the protocols for the Alaska Off-road Breeding Bird Survey (Handel 2002) was delineated with a GPS and marked with metal rebar stakes on 1 June 2002 (Fig. 1). Surveyor's flags were placed every 10 m out to 100 m and every 25 m to 250 m from each stake to help with estimation of distances to birds detected. Plant cover also was identified within 50 m of center stakes and recorded according to the standard protocol (Handel 2002). On 14 June 2007, Jeff Williams conducted the survey of the same points again according to established methods (e.g. all birds detected during 5 minutes at each plot were delineated in survey booklets).

Other Observations

In addition to the more structured surveys, we kept track of all species of wildlife encountered during the work at Avatanak. In 2002 we surveyed interior plots for rock sandpipers (*Calidris ptilocnemis*), but we were unable to resurvey these same areas in 2007.

RESULTS

The following accounts characterize the status of different types of birds before (2002) and after (2007) fox removal at Avatanak Island. We used information from nearshore coastline surveys (Table 1), beach surveys (Table 2), lake surveys (Table 3), and off-road point counts (Table 4) to make comparisons for these species and species groups most likely to experience significant population changes as a result of the removal of introduced foxes. Summaries of information for all species observed (Appendix A), details of beach surveys (Appendix B), and details of coastline surveys (Appendix C) are attached to the report after the following accounts of our findings for selected species.

Waterfowl

The species composition of waterfowl seen on freshwater lakes and streams was similar in 2002, during fox removal in 2004 (Thomson 2004) and 2007. The primary species observed in all years were mallard (*Anas platyrhynchos*), green-winged teal (*Anas crecca*), and red-breasted merganser (*Mergus serrator*). Other species seen in at least one year were tundra swan (*Cygnus columbianus*), northern pintail (*Anas acuta*), northern

shoveler (*Anas clypeata*), bufflehead (*Bucephala albeola*), and common merganser (*Mergus merganser*, see Appendix A).

Foxes typically make it difficult for any species of ducks to successfully breed unless they are on inaccessible islands in lakes or offshore. In 2002, we only found one mallard nest and a predated egg that may have been from a green-winged teal. In 2007 we found evidence of nesting for northern pintail (female with a brood), and green-winged teal (single males remaining in areas near apparent nesting sites (e.g., the island in Flying Monkey Lake). We also saw single male mallards and red-breasted mergansers in 2007 that could have suggested females were nesting nearby although we were unable to confirm nesting. A few more teal were seen in 2007 than in 2002 (Appendix A), but there was little apparent difference in numbers of ducks seen on lakes (Table 3). Overall it appeared breeding ducks have begun to increase on Avatanak, particularly green-winged teal.

The most common duck in the nearshore marine waters was harlequin duck (*Histrionicus histrionicus*) (Table 1), but this species is not known to breed in the Aleutians, so the birds at Avatanak were likely non-breeders summering in the area (Gibson and Byrd 2007). Since they don't breed and seldom come ashore, harlequin duck populations probably are not affected much by foxes, and indeed maximum counts were similar in 2002 and 2007 (Table 1). Although common eiders (*Somateria mollissima*) are one of the species that typically respond well following removal of introduced foxes elsewhere in the Aleutians (Byrd et al. 1994), we did not observe this species near Avatanak (Table 1, Appendix A). Common eiders could eventually be expected to repopulate the island if regional populations expand.

Rock Ptarmigan

In 2002, a great deal of the island's interior was traversed while walking to and surveying the shorebird plots, point count route, and lake surveys. In 2007, we did not conduct the shorebird plot surveys, so less time was spent in the interior of the island. No rock ptarmigan (*Lagopus mutus nelsoni*) were seen on the point count survey in either year (Table 4), but droppings were found near one count point in 2007 indicating recent presence. In 2002 only 2-3 ptarmigan were seen per day by the shorebird crew (see Byrd and Williams 2002), and in 2004, during the fox eradication work, "singles and pairs" were seen in the upland areas but the species was "not common" and was never seen near beaches (Thomson 2004, p.14). In 2007, C. Berg and C. Rauch made one trip through the upland between Avatanak Bight and "Dead Cow Cove" (so named by Thomson 2004, p. 4) and they saw 4 ptarmigan and found one nest. Ptarmigan typically increase substantially after foxes are removed (Bailey 1993), but Aleutian ptarmigan also experience natural population fluctuations in the absence of foxes (S. Ebbert, pers. comm.). We did not have sufficient evidence to evaluate ptarmigan recovery.

Cormorants

As is common with cormorant breeding colonies, birds shifted nesting locations between 2002 and 2007 (Fig. 2). As shown, most breeding cormorants were in a single colony at a new location on the east side of the island in 2007. More than 4 times as many cormorants were found in 2007 than in 2002, and every species increased (Table 1). In 2007, some of the nests were in areas that looked as if they would have been accessible to foxes before the eradication.

Black Oystercatcher

No evidence of nesting was found for this species in 2002 (Byrd and Williams 2002) or 2004 (Thomson 2004). In 2002 the high daily count was 13 which included singles and flocks of up to 5. All these birds were mobile and most were flushed from offshore rocks, not the main island. The maximum and average number of oystercatchers noted on boat based coastline surveys in 2007 were only slightly higher than in 2002 (Table 1), but the difference was that most birds we observed in 2007 were in pairs. We noted at least 2 defensive pairs; in sections H (Appendix C) and I (Appendix B) indicating the likely presence of chicks. It appears recovery is underway for this species.

Other Shorebirds

In 2002 the shorebird crew recorded rock sandpipers on 6 of the 23 plots they surveyed indicated the species was able to persist, at least at low densities when foxes were present. Least sandpipers (*Calidris minutilla*) also were found nesting in 2002. Since we could not resurvey the shorebird plots, we compared sandpiper observations on the point count route (Table 4), and concluded that there may have been a slight increase in rock sandpipers between 2002 and 2007.

Glaucous-winged Gull

Gull nests are particularly susceptible to fox predation, and the only nesting birds we saw in 2002 were on offshore rocks or on a single cliff area inaccessible to foxes (Fig.2). In 2007 gulls were nesting on the main island in areas that would have been accessible to foxes prior to eradication. The total number of gulls counted increased more than 4 fold between 2002 and 2007 (Table 1). We found colonies mid-way through section A (exact location not noted), in the vicinity of the cormorant colony in section G, and in section H (Fig. 2). Also we recorded at least 8 instances of one or two pairs nesting on the mainland, away from the two colonies. This pattern of isolated pairs was also seen in the western Aleutians as gulls begin to recovery after fox removal (V. Byrd, pers. obs.).

Pigeon Guillemot

In 2002, the maximum count of guillemots was 139 during the early morning nearshore boat surveys. Similar counts in 2007 suggested this species has increased based on a

maximum count of more than 200 birds (Table 1). This species increased in two other studies after fox removal (Byrd et al. 1994, 1997).

Tufted Puffin

Puffins usually are unable to successfully nest in typical earthen burrows on islands with introduced foxes. In 2002, we noted a single breeding colony in an area too steep for foxes to access, and several birds were seen flying into crevices in cliffs where they also were safe from foxes (Fig. 2) and we counted more than 250 birds on two of the morning coastline surveys (Table 1). Maximum and mean counts were higher in 2007 and we found several areas on the mainland where puffins were apparently nesting in spots that would have formerly been accessible to foxes (see Fig. 2 for locations of mainland colonies). Williams (unpubl. data) documented a substantial increase in puffins after fox removal in the western Aleutians.

Passerines

Introduced foxes are known to prey on some species of song birds but typically do not extirpate these species (Bailey 1993) and population-level effects are not well documented. At Avatanak, the species potentially most affected by foxes would be bank swallow (*Riparia riparia*) since many of the low sandy banks which provide potential nesting habitat were accessible to foxes. Indeed, in 2007 we found at least one nesting colony of bank swallows that would have been accessible to foxes prior to eradication. The number of bank swallows observed on beach and lake surveys also increased in 2007 (Tables 2 and 3). Other common species of passerines noted at Avatanak included: winter wren, savannah sparrow (*Passerculus sandwichensis*), song sparrow, Lapland longspur (*Calcarius lapponicus*), and American pipit (*Anthus rubescens*). There appeared to be larger numbers in 2007 than 2002 for most species (Tables 3 and 4), but some of the increase might have been the result of later surveys in 2007 than in 2002 and the consequent presence of increased numbers of fledglings (for winter wren and song sparrow only). Interestingly, the influx of Eurasian skylarks (*Alauda arvensis*) in 2002, an unusual event in the eastern Aleutians (Gibson and Byrd 2007), was followed in 2007 with the observation of a single bird on Avatanak (Appendix A).

Other Wildlife Observations

We recorded 45 species of birds and 3 species of marine mammals during surveys on Avatanak in 2002 (Byrd and Williams 2002), 2004 (Thomson 2004), and 2007 (this report) (Appendix A). Avatanak had a diverse and dense group of raptors. We found up to 14 active bald eagle territories in 2007 (Fig. 2) and counted up to 48 adults and 17 juveniles. Tundra voles (*Microtus oeconomus*) probably accounted for the presence of golden eagles (*Aquila chrysaetos*), at least 2 different birds, and 2 to 3 pairs of rough-legged hawks (*Buteo lagopus*) observed each survey year.

Sea otters (*Enhydra lutris*), which have declined in the central and western Aleutians in the past 15 years, are apparently maintaining at least moderate populations at Avatanak

(up to 27 adults). Harbor seals (*Phoca vitulina*) also occurred in fairly high densities (Table 1).

DISCUSSION

In 2002, the bird life on Avatanak was similar to other islands in the Aleutians with foxes. We found little evidence of nesting by waterbirds (loons and ducks), no surface-nesting seabirds (gulls and terns) on most of the island, no black oystercatchers nesting near beaches, and low densities of nesting sandpipers in upland areas. Rock ptarmigan populations also were very low, and burrow nesting seabirds (puffins) apparently were restricted to small populations nesting in inaccessible areas. The larger songbirds like song sparrows were not very common. Crevice-nesting species like pigeon guillemots were present in moderate numbers.

In 2007, following removal of introduced foxes in 2004 (only 3 years earlier), we saw evidence that recovery of birds was already underway. We found greater evidence of increased waterbird nesting. Glaucous-winged gulls were again nesting on the mainland and populations had increased substantially. We also found evidence that black oystercatchers are again nesting on Avatanak. Pigeon guillemot numbers appeared to have increased, and tufted puffins apparently had expanded their nesting areas on the island. Furthermore, cormorants and bank swallows were seen nesting in 2007 in areas that would have been accessible to foxes prior to eradication.

Despite the fact that 2007 was only the third or fourth breeding season that birds have benefited from reduced (in 2004) or eliminated (2005-2007) fox predation, it is clear that restoration of the breeding birds at Avatanak is underway based on increases in the majority of bird species we would have expected to have been limited by fox predation.

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Table 1. Counts of selected species on coastline survey at Avatanak I., 12-14 June, 2007.

Species	12-Jun	13-Jun	14-Jun	Max 2007	Mean 2007	Max 2002	Mean 2002	Difference in Max. 2002-2007 ^a
HADU ^b	93	39	64	93	65.3	99	81.0	=
DCCO	114	* ^c	*	114	-- ^d	32	16.3	+
DCCO(nest)	30	*	*	30	--	15	5.0	+
PECO	157	*	*	157	--	25	13.7	+
PECO (nest)	42	*	*	42	--	14	4.7	+
RFCO	243	*	*	243	--	29	15.0	+
RFCO (nest)	152	*	*	152	--	0		+
UNCO	22	*	*	22	--	79	53.7	-
UNCO (nest)	41	*	*	41	--	0		+
Total Cormorants	536			536	--	126	98.7	+
BAEA (ad)	46	42	48	48	45.3	37	32.0	+
BAEA (im)	17	4	10	17	10.3	7	5.7	+
BAEA (nest)	7	10	5	14		8		+
RLHA	2	0	6	6	2.7	6	2.0	=
BLOY	12	16	13	16	13.7	13	9.3	+
GWGU	733	556	499	733	596.0	162	155.3	+
CORA	22	19	15	22	18.7	13	11.7	+
PIGU	166	124	202	202	164.0	139	135.0	+
TUPU	374	484	307	484	388.3	274	213.3	+
HOPU	62	104	73	104	79.7	108	85.3	=
SEOT (ad)	29	14	14	29	19.0	27	19.7	=
SEOT (pup)	7	4	5	7	5.3	9	4.0	=
HASE (ad)	117	165	131	165	137.7	70	56.3	+
HASE (pup)	10	6	9	10	8.3			
SSLI	72	57		72	47.3	24	22.3	+

^a“+” indicates increase by >10%, “-“ means decrease by >10%, “=” means within 10%

^bCodes for species use first two letters of each name (e.g. HADU is Harlequin Duck). See Appendix A for full names.

^cAsterisks mean the colony was not counted on these dates.

^dDashes indicate no mean calculated because only single count.

Table 2. Summary of observations of birds on beach surveys at Avatanak 1-2 June 2002 and 12 June, 2007.

Location	<u>Winter Wren</u>		<u>Song Sparrow</u>		<u>Oystercatcher</u>		<u>Bank Swallow</u>	
	2002	2007	2002	2007	2002	2007	2002	2007
Chimney Cove Beach	2	3	4	8	0	0	0	25
Trapper Cove Beach	1	5	3	5	0	0	0	6
West Mountain Beach	20	33	4	19	0	0	0	0
Section I Beach	10	8	7	20	0	2	0	0
Beach w. of Trapper's Cove	19	21	13	24	0	0	0	0
Totals	52	70	31	76	0	2	0	31

Table 3a. Surveys of lakes on Avatanak Island, Alaska^a, 1 June 2002 and 12-13 June 2007. Parentheses indicate data from 2007.

Species	Tinman 1	Scarecrow 2	Auntie Em's 3	Lion 4	Flying Monkey 5	Dorothy 6	Twister 7	Westwitch 8 ^b	Toto 9	Eastwitch 10	Total
Northern pintail					0 (1 ^c)						0 (1)
Aleutian green-winged teal					1 (3)		1 (1)				2 (4)
Bald eagle	0 (1)	0 (1)			1 (2)						1 (4)
Rock sandpiper					1 (1)						1 (1)
Least sandpiper							0 (1)			1 (0)	1 (1)
Glaucous-winged gull					0 (70+)						0(70+)
Short-eared owl					0 (1)						0 (1)
Bank swallow					1 (5)					0 (20)	1 (25)
Winter wren					1 (2)		1 (1)			2 (0)	4 (3)
American pipit				1 (0)			0 (4)	1 (0)			2 (4)
Savannah sparrow		0 (2)	0 (5)	0 (1)	11 ^d (26)	10 (0)	4 (1)		3 (0)	6 (0)	34(35)
Song sparrow					2 (0)	2 ^e (0)	1 (0)			4 (0)	9 (0)
Lapland longspur	1 (0)	1 (0)	1 (0)	2 (0)	7 (1)	11 (0)	1 (0)	3 (0)			27 (1)
Eurasian skylark					3 (0)	1 (0)		1 (0)		2 (0)	7 (0)

^a See Fig. 1 for lake locations (indicated by numbers).

^b Lake was dried up in 2007

^c Female with 7 ducklings.

^d Two nests, 5 and 4 eggs, respectively.

^e One nest with 4 eggs.

Table 3b. Location of lakes surveyed on Avatanak Island, Alaska (datum WGS-84).

Lake	Number	Latitude	Longitude	GPS location
Scarecrow	2	54° 05.09 N	165° 21.86 W	-
Auntie Em's	3	54° 05.04 N	165° 22.14 W	SE end
Lion	4	54° 05.10 N	165° 22.16 W	S end
Flying Monkey	5	54° 04.57 N	165° 22.21 W	SW end
Dorothy	6	54° 04.91 N	165° 22.77 W	N end
Twister	7	54° 04.50 N	165° 23.71 W	SE end
Westwitch	8	54° 04.52 N	165° 23.29 W	N end
Toto	9	54° 04.34 N	165° 23.23 W	NE end
Eastwitch	10	54° 04.36 N	165° 22.78 W	NW end

Table 4. Birds observed on Off-Road Point Count route 363, Avatanak Island, Alaska, 1 June 2002 and 14 June 2007. Includes birds observed on the ground and flying over the census area. Parentheses indicate data from 2007.

Species	1	2	3	4	5	6	7	8	9	10	11	12	Total
Bald eagle	2 (1)		0 (1)									1 (0)	3 (2)
Rough-legged hawk					1 (0)								1 (0)
Rock sandpiper		0 (1)	0 (2)	1 (1)	2 (0)			1 (0)		0 (1)	0 (1)		4 (6)
Least sandpiper				0 (1)			1 (0)						1 (1)
Glaucous-winged gull	1 (0)	1 (0)	9 (1)	1 (1)		0 (1)				0 (1)		1 (0)	13 (4)
Common raven							0 (2)			0 (1)		1 (0)	1 (3)
Bank swallow		1 (0)											1 (0)
Winter wren	2 (1)	1 (0)		1 (0)			2 (1)	1 (0)		2 (0)		1 (0)	10 (2)
American pipit				1 (0)		1 (0)		0 (1)		1 (0)	1 (2)	0 (1)	4 (4)
Savannah sparrow	3 (6)	1 (4)	2 (2)	2 (1)	1 (1)			0 (4)	0 (2)	1 (2)	1 (3)	0 (1)	11 (26)
Song sparrow	1 (0)	0 (1)										0 (1)	1 (2)
Lapland longspur	1 (1)	2 (2)	1 (2)	1 (4)	3 (1)	2 (2)	2 (2)	3 (1)	3 (4)	1 (1)	1 (2)	2 (1)	22 (23)
Rosy finch					0 (1)	0 (1)			1 (1)	1 (1)			2 (4)
Eurasian skylark			1 (0)		1 (0)					1 (0)	1 (0)		4 (0)

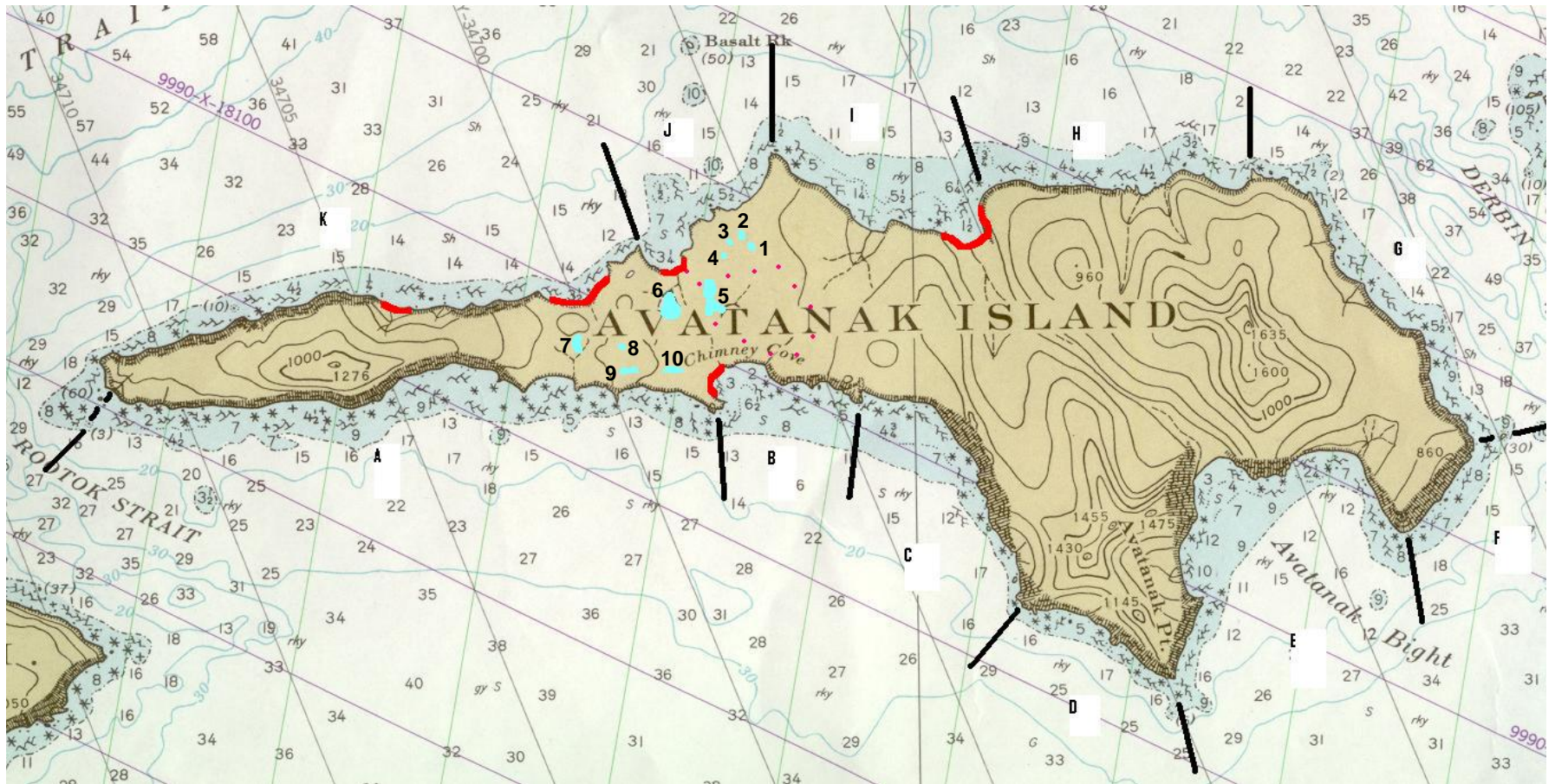


Figure 1. Map of Avatanak Island, Alaska. Dark black lines indicate coastline survey segments, light blue areas indicate lakes, purple dots indicate point count locations, red irregular lines indicate beach survey locations in 2002 and 2007.

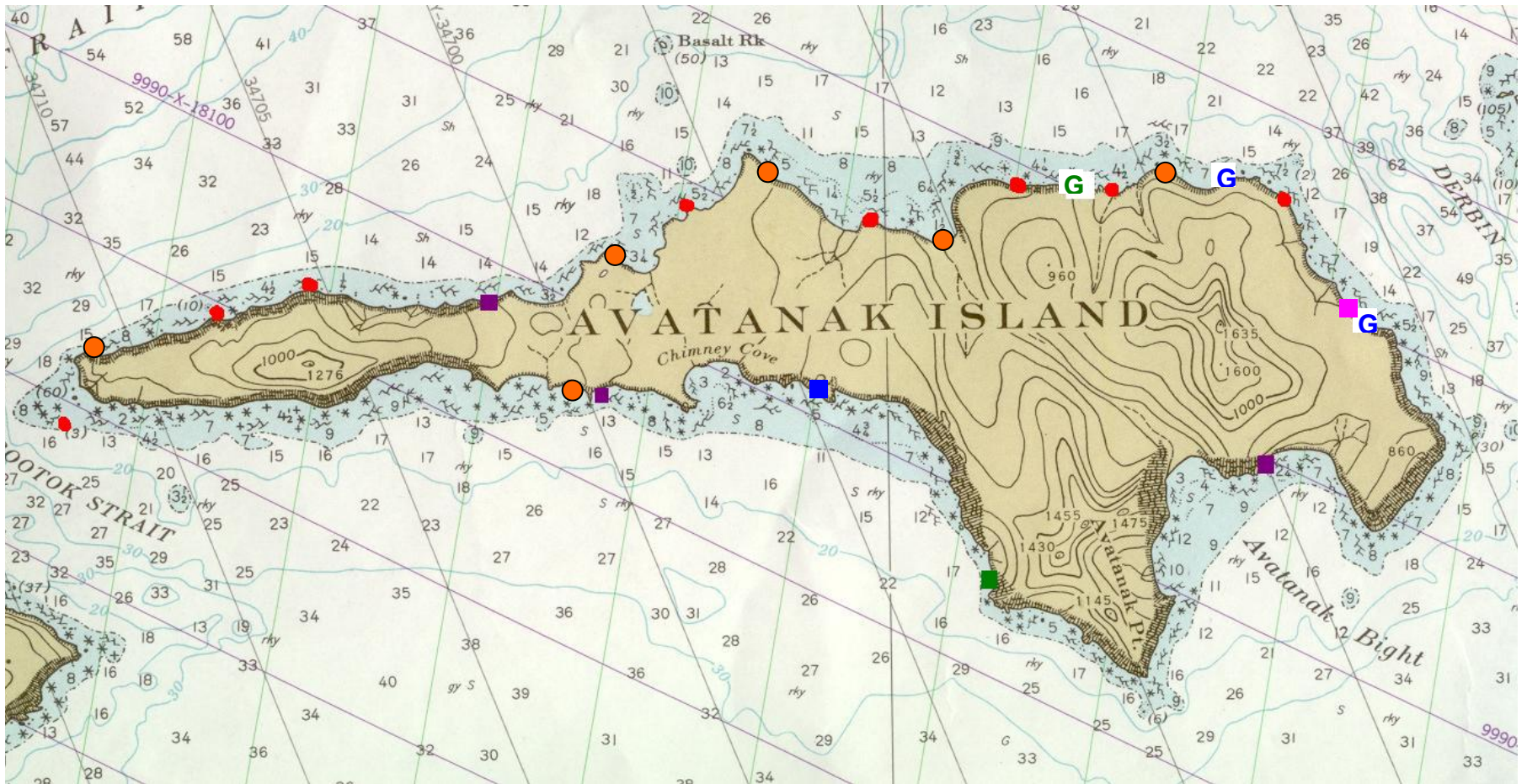


Figure 2. Map of Avatanak Island, Alaska, showing location of bald eagle nests (red circles for 2002, all still occupied in 2007; orange circles for new eagle nests in 2007), cormorant colonies (purple squares for 2002; pink squares for 2007), puffin colonies (green squares for 2002, still occupied in 2007; blue squares for new colonies in 2007), and glaucous-winged gull colonies (green letter G for 2002, still there in 2007; blue letter G for 2007) in 2002 and 2007.

Appendix A: Annotated List of Species Observed at Avatanak Island, 2002 (Byrd and Williams 2002), 2004 (Thomson 2004), and 2007 (this report).

Tundra Swan (*Cygnus columbianus*) [TUSW]: Three were seen on a freshwater lake on 15 June 2004.

Mallard (*Anas platyrhynchos*) [MALL]: In 2002, a female was flushed from a nest and a second female was seen in a creek. In 2004, a female was seen with a brood, and another pair was observed. In 2007, two separate single males were observed in creeks, exhibiting behavior suggesting females might have been nesting nearby.

Northern Shoveler (*Anas clypeata*) [NOSH]: A pair was seen in 2004.

Northern Pintail (*Anas acuta*) [NOPI]: A female was observed on the lake near Camp Cove, which Thomson (2004) called Arrowhead Lake, with 7 ducklings less than one week old on 12 June. The species had not been recorded in previous surveys at Avatanak.

Green-winged Teal (*Anas crecca nimia*) [GWTE]: In 2002, a pair and two males were noted as well as a predated egg suggesting nesting. In 2004, Thomson was present throughout the nesting season, and he found a nest and a brood plus up to 6 birds at a time. In 2007, when we were present only June 12-14, we saw no females (presumably any present were nesting or had small broods and were inconspicuous) but we saw males in several creeks, in the nearshore marine water off Camp Cove, and in one lake. Three males near an island in Flying Monkey Lake were reluctant to leave and likely represented nesting pairs there.

Harlequin Duck (*Histrionicus histrionicus*) [HADU]: Numbers seen on daily coastline surveys varied from 55 to 99 in 2002 and from 39 to 94 in 2007.

Bufflehead (*Bucephala albeola*) [BUFF]: One female was seen on “Arrowhead” Lake (see Thomson 2004 for location) on June 12 and probably the same bird was seen in nearshore marine waters the next day.

Common Merganser (*Mergus merganser*) [COME]: A flock (up to 14) of apparent non-breeders was present in mid-June in 2004.

Red-breasted Merganser (*Mergus serrator*) [RBME]: One or possibly two pairs were seen in nearshore waters on the north side of the island on 2 June 2002, and Thomson saw two females and a male in a lake on 12 May 2004. We saw a single male in nearshore marine waters on June 12, 2007.

Rock Ptarmigan (*Lagopus mutus nelsoni*) [ROPT]: Approximately 2-3 seen each day during extensive walking on the shorebird plots in 2002, and Thomson (2004) considered the species uncommon at Avatanak, although he found two nests over the summer. In 2007, we spent little time in the upland, where the species was noted in 2002, but in a

single trip into that habitat 4 birds were seen including a nest.

Common Loon (*Gavia immer*) [COLO]: One bird was seen in nearshore marine waters in 2004.

Double-crested Cormorant (*Phalacrocorax carbo*) [DCCO]: The species nested at Avatanak in all three years of observation, but locations of colonies shifted among years. Only one colony was noted in 2002, three breeding locations were documented in 2004, and again a single colony was delineated in 2007. Numbers of birds were highest in 2007 (up to 214 compared to 32 in 2002). Some birds were seen on a freshwater lake in 2004.

Red-faced Cormorant (*Phalacrocorax urile*) [RFCO]: This species was the most common of the three species at Avatanak in 2007, where numbers of red-faced cormorants were up about 8 fold from 2002.

Pelagic Cormorant (*Phalacrocorax pelagicus*) [PECO]: Like the other two species of cormorants more pelagic cormorants were seen in 2007 than in 2002. As different from the others in 2007, there was a second colony, probably of this species indicated by the presence of abandoned nests in a cave (at least 6 nest structures).

Unidentified Cormorant (*Phalacrocorax* spp.) [UNCO]: Not all cormorants could be identified on surveys, so we had a category for these individuals. A higher percentage of cormorants were identified to species in 2007 than in 2002, so this category had fewer birds in it in 2007.

Bald Eagle (*Haliaeetus leucocephalus*) [BAEA]: In 2002, a total of 37 adults and 7 juveniles were counted. In 2007, numbers were 48 adults and 17 juveniles. Eagles were flying over the island and could have been double counted in a few cases, but it is clear that bald eagles were particularly common at Avatanak. It appears the nesting population increased between 2002 and 2007. A total of 8 nests were found in 2002, but some may have been missed because repeated surveys in 2004 revealed the presence of 13 active nests (Thomson 2004). We found 14 active territories in 2007 (Fig. 2).

Rough-legged Hawk (*Buteo lagopus*) [RLHA]: At least 2 and possibly 3 pairs were seen along the north shore in 2002, one nest was found and there were possibly 2 other occupied territories in 2004, and we could account for at least 3 pairs in 2007. We found one nest on the northwest coast in 2007.

Golden Eagle (*Aquila chrysaetos*) [GOEA]: One adult was seen inland and at least one additional bird was seen near the coast in 2002, and one sub-adult was seen on 13 June 2007 near the coast.

Peregrine Falcon (*Falco peregrinus*) [PEFA]: Possibly two birds were seen in 2002, there were two sightings in 2004, and one was seen on the cliffs in Segment C on 12 June 2007. No nests were found.

Semipalmated Plover (*Charadrius semipalmatus*) [SEPL]: A lone bird was seen in late May 2004 (Thomson 2004), and we found a single on Section I beach on 12 June 2007.

Black Oystercatcher (*Haematopus bachmani*) [BLOY]: Oystercatchers did not appear to be nesting on Avatanak in either 2002 or 2004, although birds were present in both years. In 2007 we recorded territorial and highly defensive pairs in segments H, I (specifically on Segment I sample beach). Nearly all individuals observed in 2007 were in pairs.

Wandering Tattler (*Heteroscelus incanus*) [WATA]: A single bird was seen on an offshore rock on 2 June 2002, and probably three different individuals were seen mid-late May 2004 (Thomson 2004).

Least Sandpiper (*Calidris minutilla*) [LESA]: At least one nest was found in 2002, and Thomson found evidence of nesting (flightless young and a distraction display) in 2004. In 2007, we encountered one bird that gave a distraction display near “Arrowhead” lake, and the species was seen occasionally on beaches as well.

Rock Sandpiper (*Calidris ptilocnemis*) [ROSA]: Rock sandpipers nested at Avatanak in at least low densities when foxes were present based on inland surveys conducted in 2002 (Byrd and Williams 2002). In 2004, Thomson saw 6 to 11 regularly on the beach in the vicinity of Camp Cove, and he found one nest in an upland area. We were not able to resurvey the inland plots set up in 2002, but slightly more rock sandpipers were seen on the point count route in 2007 than in 2002, and territorial birds were seen around some of the lakes we surveyed.

Glaucous-winged Gull (*Larus glaucescens*) [GWGU]: In 2002, one nesting colony was found on the main island of Avatanak on a steep hillside that probably was not accessible to foxes. Although he saw nests on offshore rocks, Thomson (2004, p 25) characterized gulls as “Overall few birds were nesting and only in places inaccessible to foxes”. In 2007 numbers of gulls had increased substantially (maximum counts on coastline surveys 733 in 2007 compared to 162 in 2002) and birds were nesting in areas that would have been accessible to foxes prior to eradication.

Black-legged Kittiwake (*Rissa tridactyla*) [BLKI]: Thomson (2004) saw up to 65-70 kittiwakes feeding in Rootok Strait and we saw birds (up to 26) feeding in Derbin Pass. These probably were coming from the nearby nesting colony at Derbin Island to the east.

Common Murre (*Uria aalge*) [COMU]: There was no evidence of murre breeding at Avatanak, although Thomson (2004) saw single birds in nearshore marine waters.

Pigeon Guillemot (*Cephus columba*) [PIGU]: In 2002, the maximum count of guillemots was 139 compared to 202 in 2007. The averages between the two years were not as different, largely because one of our 2007 counts (June 13) extended too late into the day, after guillemots had dispersed from the nearshore zone, on the north side of the island where densities were highest. The maximum counts demonstrate that this species is beginning to increase following introduced fox removal.

Ancient Murrelet (*Synthliboramphus antiquus*) [ANMU]: A few were seen in near shore waters in each of the years of survey.

Least Auklet (*Aethia pusilla*) [LEAU]: Thomson (2004) reports seeing 12 near the island in 2004.

Whiskered Auklet (*Aethia pygmaea*) [WHAU]: An apparently sick bird, based on its lethargy, was seen on the north side of Avatanak on 1 June 2002.

Horned Puffin (*Fratercula corniculata*) [HOPU]: This species probably is not particularly affected by foxes since most appear to nest in crevices on steep sea cliffs at Avatanak. Indeed numbers (approximately 100) seen on nearshore boat surveys were similar in 2002 and 2007.

Tufted Puffin (*Fratercula cirrhata*) [TUPU]: A single nesting site was noted in 2002 in an area apparently inaccessible to foxes, and up to 274 were counted on coastline surveys (Byrd and Williams 2002). Thomson (2004) confirmed the nesting area on the south side of the island. In 2007 more birds were seen around the island than previously; maximum counts on coastline surveys (Table 1), and at least one new nesting area on the main island was detected along with an expansion to an adjacent area near the previously existing colony (Fig. 2).

Short-eared Owl (*Asio flammeus*) [SEOW]: There were four different sightings of a single owl in May and June 2004 (Thomson 2004), and we saw one owl in June 2007.

Common Raven (*Corvus corax*) [CORA]: Up to 13 were seen daily in 2002, and 22 was the maximum daily counts in 2007 (Table 1). The species nests on Avatanak; one nest in 2002 and two nests in 2004 (Thomson 2004).

Eurasian Skylark (*Alauda arvensis*) [EUSK]: Up to 5 were seen in 2002, and at least one singing male was seen and heard on 13 June 2007. This Asiatic stray was not seen in 2004 (Thomson 2004).

Bank Swallow (*Riparia riparia*) [BASW]: Two individuals were seen at Avatanak in late May 2002, but during the 2-month period of field work there in 2004, Thomson (2004) noted up to 25 birds present, mostly near Camp Cove. In 2007, we found this species to be fairly common near lakes and beaches and we found them nesting in low sandy bluffs near Chimney cove and Camp Cove (also called Trapper's Cove) in areas where foxes could have dug them out.

Winter Wren (*Troglodytes troglodytes*) [WIWR]: Wrens were abundant. Not only did we see and hear them on coastline surveys in 2002 and 2007 (e.g., up to 85 counted on 2 June 2002), but wrens were also seen inland as well. We found more wrens in 2007 than 2002 on beach surveys, but fewer wrens were seen on point counts in 2007.

American Dipper (*Cinclus mexicanus*) [AMDI]: A single bird was singing on a creek on the east end of the island in 2002, but none were noted in 2004 or 2007.

American Pipit (*Anthus rubescens*) [AMPI]: In 2002, the upland surveys indicated the species was common in those habitats. Pipits were seen in 2004 and 2007, but there were no comparable surveys to 2002. It is unlikely that foxes affected these birds very much.

Savannah Sparrow (*Passerculus sandwichensis*) [SASP]: This was one of the most common passerines on Avatanak, and it appeared there was an increase between 2002 and 2007 based on the off-road point count survey (Table 4).

Song Sparrow (*Melospiza melodia*) [SOSP]: It appeared populations were higher in 2007 than in 2002 based on the beach surveys (Table 2), but the magnitude of the increase may not have been as great as suggested due to the presence of some fledglings during the 2007 survey.

Golden-crowned Sparrow (*Zonotrichia atricapilla*) [GCSP]: One was heard near the cove in Segment I on 1 June 2002, but the species was not recorded in 2004 or 2007.

Lapland Longspur (*Calcarius lapponicus*) [LALO]: The species was observed fairly commonly in 2002, 2004, and 2007. There was no indication of change in population levels between 2002 and 2007 based on the point count survey (Table 4).

Snow Bunting (*Plectrophenax nivalis*) [SNBU]: Up to 8-10 were seen in scree slopes at high elevation in 2002, and the species was also found in these same habitats in 2004 (Thomson 2004). We did not have sufficient data in 2007 to make comparisons, since we spent less time in the upland areas that year.

Gray-crowned Rosy-Finch (*Leucosticte tephrocotis*) [GCRF]: A few were seen on sea cliffs and in upland areas during surveys in each year. Four birds were seen on the point count survey in 2007 compared to two birds in 2002 (Table 4).

Sea otter (*Enhydra lutris*) [SEOT]: Up to 27 adults and up to 9 pups were seen on the coastline surveys in 2002, similar to the counts of 29 adults and 7 pups in 2007 (Table 1).

Harbor Seal (*Phoca vitulina*) [HASE]: Up to 165 harbor seals were seen during coastline surveys in 2007, up from a peak of 70 adults in 2002 (Table 1). A major concentration location was near the western point of Avatanak at Rootok Pass.

Steller Sea lion (*Eumatopias jubatus*) [STSL]: The peak count, including scattered individual animals in the water around Avatanak's coastline was 72 in 2007, higher than in 2002. In 2007, the primary location where we saw sea lions was on an offshore rock in section G. We had conditions to make a rough count from a distance on June 12, but we did not approach the area closely again.

Tundra Vole (*Microtus oeconomus*): We saw a lot of digging, particularly in drainages,

and we saw occasional voles. Rough-legged hawks, short-eared owls, and maybe golden eagles are probably feeding on these. We found half eaten carcasses and pellets/castings containing voles at several places around the island. We did not notice a change in the areas occupied by voles or the density of digging between 2002 and 2007.

Sandlance (*Ammodytes hexapterus*): At least 2 “balls” of age 1 or 2 fish (5-6 cm) were seen nearshore on the north shore during boat surveys for birds in 2002.

Sticklebacks: We observed numerous fish up to 4 inches in length in Twister, Flying Monkey, and Eastwitch lakes, but did not have time to capture any to confirm identification. Smaller fish, possibly of the same species were abundant in the same lakes. We assume the fish were most likely sticklebacks.

Appendix B. Birds Observed on Beach Surveys at Avatanak Island, 12-14 June, 2007 (Datum WGS-84).

Chimney Cove Beach

Date: 12 June
Time: 10:30-11:00
Observer: J. Williams, C. Berg
Start Location: 54 04.41N, 165 22.12W
End Location: 54 04.21N, 165 22.31W
Weather: NW 15, overcast, no precip.

WIWR: 3 adults, incl. 2 singing males
SOSP: 8 including 2 singing males, one nest with nestlings (eyes not open)
SASP: 2 singing males, 1 other
BASW: 25 birds nesting in cliff (accessible to foxes), three nest holes examined
ROFI: 1
BAEA: 1

Trapper Cove Beach

Date: 12 June
Time: 1300-1320
Observer: V Byrd, C Corin
Start Location: 54 05.10N, 165 22.02W
End Location: 54 04.21N, 165 22.58W
Weather: nw15, overcast, no precip.

WIWR: 1 singing, 1 adult not singing, 3 fledglings
SOSP: 1 singing, 2 other adults, 2 fledglings
SASP: 2 singing, 3 other
BASW: 6 feeding on insects in kelp wreck on sand beach

West Mountain Beach (mostly boulders, backed by steep hillside)

Date: 12 June
Time: 13:20-13:56
Observer: J Williams, C. Berg
Start Location: 54 04.83N, 165 25.34W
End Location: 54 04.91N, 165 25.95W
Length: 820 m
Weather: nw15, overcast, no precip.

SOSP: 5 singing males, 14 other incl fledglings
WIWR: 7 singing males, 26 others incl fledglings
GCRF: 7

SASP: 2
PEFA: 1

Section I East Beach (to 50 m inland) sand in the middle, boulder elsewhere, stream in center backed by valley, rest backed by steep hillsides

Date: 12 June
Time: 1605-1635
Observer: J. Williams, C. Berg
Start Location: 54 05.46N, 165 19.43W
End Location: 54 05.27N, 165 20.04W
Length: 600 m
Weather: nw 15, overcast, no precip.

WIWR: 4 singing males, 4 others
SOSP: 2 singing males, 18 others incl. 5 fledglings
ROSA: 5
SASP: 2 singling males, 6 others
SEPL: 1
BLOY: Defensive pair, prob. Nesting
LESA: 1
GWTE: 6 male, 4 female

Beach w. of Trappers Cove Beach (mostly boulders, backed by steep cliffs and hillsides, stream in middle)

Date: 12 June
Time: 1309-1411
Observer: J. Williams, C. Berg
Start Location: 54 05.02N, 165 23.41W
End Location: 54 04.89N, 165 24.15W
Weather: nw 15, overcast, no precip.

WIWR: 9 singing, 9 others (probably including some fledglings)
SOSP: 5 singing, 19 others (probably including some fledglings)
CORA: 2
SASP: 1 singing, 2 others
GWGU: 4
BAEA: 2
GCRF: 1
RLHA: one on nest near beach

New Beach: E. of Trappers Cove Beach

Date: 13 June

Time: 17:35-18:09
Observer: L. Matlock, P. Benson
Location: about 54 08.9, 165 03.72W
WIWR: 2 singing 5 others
SOSP: 1 singing, 3 others
Golden Eagle: 1 flew over
GCRF: 1

New Beach: Avatanak Bight Beach

Date: 14 June
Time: 13:20-14:31
Weather: Sunny wind nw 25
Observer: L. Matlock, P. Benson
Begins: 54 06.242 N, 165 27.739 W
End: 54 05.747N, 165 28,481W
SOSP: 1 singing, 11 others
WIWR: 4 singing, 8 others
SASP: 5
HASE: 1

Appendix C. Table C.1. Counts of Birds and Marine Mammals along the coastline of Avatanak I. 12 June 2007

Species	A	B	C	D	E	F	G	H	I	J	K	Total
Time	9:00-10:20	10:20-10:40	10:21-10:50	9:56-10:20	8:53-9:42	8:35-8:48	7:28-8:30	6:52-7:25	6:45-7:25	7:25-7:55	7:55-8:00	
Cond.	good	good	good	good	good	good	good	good	good	good	good	
Observ.	JW,CB, PB	JW,CB,PB	VB,CC,LM	VB,CC,LM	VB,CC,LM	VB,CC,LM	VB,CC,LM	VB,CC,LM	JW,CB,JW	JW,CB,PB	JW,CB,JW	
PIGU	2		5	12	17	9	30	18	5	51	17	166
BLOY	1				2		5		1	1	2	12
HADU	4	20	5		43		14	7				93
TUPU	35	70	22	102	51		59	21	12		2	374
HOPU	4		23	10	12	4	9					62
GWGU	151	20	51	72	72	7	214	81	7	19	39	733
BAEA (ad)	5	5	1	3	2	1	4	4	4	5	12	46
BAEA (im)	6								1	1	9	17
BAEA (nest)	1							2		1	3	7
DCCO			7	13	8	5	73	8				114
DCCO(Nest)							30					30
UNCO	1	1	5						12	2	1	22
UNCO (nests)		11					30					41
PECO	23	9	6	2	11	2	88	7	6	1	2	157
PECO (Nest)							42					42
RFCO	1		1	2	23		201	15				243
RFCO (Nest)						16	136					152
CORA	2				6		5	2	3	4		22
SEOT(ad)	12		3		4		9			1		29
SEOT(pup)	3					2	2					7
HASE(ad)	60	1	10		6		2	8	17	4	9	117
HASE(pup)	6		2				1		1			10
SSLI	4	2	1	1		64						72
ROSA								2				2
RLHA				1	1							2
PEFA			1									1
BLKI	1											1

Appendix C. Table C2. Counts of Birds and Marine Mammals along the coastline of Avatanak I. 13 June 2007

Species	A	B	C	D	E	F	G	H	I	J	K	Total
Time	8:51-10:07	7:15-7:51	7:40-8:15	7:11-7:40	7:14-8:15	8:15-8:36	8:30-9:27	9:27-10:30	10:30-11:15	11:15-11:26	10:25-11:17	
Cond.	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	Good	
Observ.	JW, CB, PB	JW, CB, PB	JW, CB, PB	JW, CB, PB	VB,CC,LM	VB,CC,LM	VB,CC,LM	VB,CC,LM	VB,CC,LM	VB,CC,LM	JW,CB,PB	
PIGU	11		6		21	9	23	14	4	25	11	124
BLOY	11		1					2(breed pair)	2 (pair)		5	16
BUFF											1	1
HADU	2	2	7		21		4	3				39
TUPU	23	133	160	80	18	2	52	15			1	484
HOPU	5	34	43	2	7		10				3	104
GWGU	93	20	86	47	85	45	85	44	34	1	16	556
BAEA (ad)	2	1	3			4	2	7	4	7	12	42
BAEA (im)									1	2	1	4
BAEA (nest)							1	2	2	2	3	10
DCCO	4	5	2	5	1	8	1*	1		3		30
UNCO	2	139	11	14	49	10	15	7	2	3		252
PECO	20	1		2	9	9	4	5	3	2	5	60
RFCO					24	7	7	2	1			41
CORA			2		5	1	5	2	4			19
SEOT (ad)	8	1					4	1				14
SEOT (pup)	3	1										4
HASE(ad)	81	1	13		2		12	34	1		21	165
HASE(pup)	1						1	1			3	6
SSLI	2			2	6	4	42		1			57

*Birds at the breeding colony not counted again (see Table C1)

Appendix C. Table C.3. Counts of Birds and Marine Mammals along the coastline of Avatanak I. 14 June 2007

Species	A	B	C	D	E	F	G	H	I	J	K	Total
Time	8:30-9:07	10:07-10:29	10:29-11:11	10:54-11:10	9:53-10:53	9:36-9:52	8:54-9:35	8:03-8:53	7:33-8:02	07:03-07:32	7:30-8:30	
Cond	Glare	Glare	Glare	No glare,windy	No Glare,windy	No glare, windy	Glare	Glare	Glare	Glare	Glare	
Observ.	CB,PB,JF	CB,PB,JF	CB,PB,JF	VB,CC,LM	VB,CC,LM	VB,CC,LM	VB,CC,LM	VB,CC,LM	VB,CC,LM	VB,CC,LM	VB,CC,LM	CB,PB,JF
PIGU	13	0	4	2	21	6	21	29	13	75	18	202
BLOY	5	0	1	0	0	0	1	3 (pr +1)	0	0	3	13
HADU	11	0	15	2	16	0	1	13	6	0	0	64
TUPU	48	18	38	29	44	1	91	6	19	2	11	307
HOPU	19	14	12	3	13	2	0	0	0	0	10	73
GWGU	85	7	67	22	50	19	95	73*	23	36	22	499
BAEA (ad)	1	0	3	0	3	0	5	9	7	8	12	48
BAEA (im)	0	0	0	0	0	0	0	2	3	1	4	10
BAEA (nest)	0	0	0	0	0	0	0	1	2	2	0	5
DCCO	0	0	7	0	2	2	3***	2	2	0	1	19
UNCO	3	0	6	11	29	28	56***	32	11	0	2	178
PECO	28	5	8	4	4	0	***	2	6	0	2	59
RFCO	0	0	1	2	2	11	3***	0	3	0	0	22
CORA	3	0	0	0	1	0	1	2	2	3	3	15
SEOT(ad)	3	0	1	0	4	3	3	0	0	0	0	14
SEOT(pup)	1	0	1	0	2	1	0	0	0	0	0	5
HASE(ad)	64	3	14	0	1	0	2	16	6	1	24	131
HASE(pup)	7	0	1	0	0	0	0	1	0	0	0	9
SSLI	0	0	0	0	5	0	1**	3	0	0	4	13
RLHA	1	0	0	0	0	0	1	0	3	1	0	6
BLKI	0	0	0	0	0	0	0	0	18	8	0	26

*nesting colony containing 35 birds about middle of section.

** haul site not counted

*** birds at colony not counted